Biogeosciences

Discussions

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Interactive comment on "Impact of land use and soil properties on soil methane flux response to biochar addition" *by* Weiwei Cong et al.

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Dear Reviewer,

Many thanks for the constructive comments and suggestions on our manuscript (bg-2017-281-SC1). We have carefully addressed all the issues raised by you in the comments. Please find our point-by-point responses under each of reviewer's comments.

The paper presents a meta-analysis investigating the impacts of biochar addition to soils on methane fluxes. It is generally well written and has accessed a wide range of data. However, I have some major concerns that should be addressed before this manuscript should be considered for publication. 1.The paper repeatedly misinterprets the Hedges' d metric. For example, in the abstract "soils with higher SOC content, C/N,

and circumneutral pH exhibited higher CH4 emission with biochar addition." It is not possible to conclude this from the metric used. Hedges' d is a probabilistic metric. If it is a positive number it says that there is an increased probability that the auxiliary variable being investigated leads to increased emissions or reduced oxidation of methane. It says nothing about absolute changes in emissions and so it is not possible to draw the conclusions that the authors have done. The manuscript needs to be re-worked to make sure this issue is clear and to avoid over interpretation of the Hedges' d.

Response: Thank you for your comments. We will rewrite the description about the soil properties and effect size (Hedges' d) in all the manuscript.

2.You have not explained how you are able to present absolute CH4 flux values, from across a range of studies that undoubtedly used different units of measurement. How have you standardised to get mg C kg soil-1 d-1? You also need to make clear which of the studies used in your meta-analysis were included in this figure, and which excluded, as it seems unlikely all would have reported with units that could be converted to the units you have used.

Response: Thank you for your recommendation. CH4 flux rates were identically transformed to amount per kilogram per day (expressed as mg C kg soil-1 d-1) according to the soil layer (or a layer of 15 cm in case of being not available) and the bulk density or bulk density estimated from soil texture (Saxton et al.,1986) reported in each study. In the cases that seasonal or annual mean soil CH4 fluxes were not reported directly, we estimated the value by dividing total CH4 emissions/uptake into average daily fluxes over the measurement period. When necessary, we contacted authors for information on parameters that were missing in the publications; if we were unable to attain the missing data, the study was excluded from the data analysis. The CH4 flux rates of 268 experimental treatments from 50 peer-reviewed articles included in this study were all transformed to amount per kilogram per day (expressed as mg C kg soil-1 d-1).

3.I have only very limited experience of linear additive models. However, I have doubts

over their application with probabilistic measures such as Hedges' d. Can they really be applied like this? Hedges' d cannot be used as an absolute value – relative comparisons can only be made between each subcategories in each individual analysis. I suggest that further comment from an independent reviewer with expertise on linear additive models is needed before this work can be considered for publication. The formatting of the manuscript still requires some work. For example, the majority of the text presented in Section 3.2 and its subsections is discussion rather than results.

Response: You are correct. We will use the raw difference instead of Hedges' d as the effect size in the models. We will reformate the manuscript to make it more readable.

4.The first line of the abstract is not objective. Biochar has also been shown to reduce crop yields and to increase greenhouse gas emissions under some conditions. This should be acknowledged.

Response: Thank you for your suggestion. We will rewrite this sentence to let the illustration about biochar's effect is objective.

5.Page 3, line 8 – You have not shown that biochar has the capacity to alter soil redox conditions or microbial activities over the short term, let alone the long term. Nor is It clear what biochar's recalcitrance has to do with either of these potential impacts.

Response: Thank you for your comment. We will rewrite this sentence: "Biochar is produced under low oxygen or anoxic conditions with the composition of the various redox active mineral and organic phases (Joseph et al., 2010; Graber, et al., 2014). Because of biochar's electrochemical properties, it has the capacity to alter soil redox conditions Eh and pH, the diversity and/or abundance of microorganisms, and influence the rate of greenhouse gas emissions from soils."

References

Graber, E., Tschansky, L. and Cohen, E.: Reducing capacity of water extracts of biochars and their solubilization of soil Mn and Fe. Eur. J. Soil Sci., 65, 162–172,

doi: 10.1111/ejss.12071, 2014.

Joseph, S., Husson, O., Graber, E. R., van Zwieten, L., Tahery- moosavi, S., omas, T., Nielsen, S., Ye, J., Pan, G., Chia, C., et al.: The Electrochemical Properties of Biochars and How They Affect Soil Redox Properties and Processes., Agron., 5, 322–340. doi:10.3390/agronomy5030322., 2015

6.Page 4, line 18 – but you used Hedges' d, which is not probabilistic metric and not a quantitative metric. So you have not conducted a "quantitative" meta-analysis, despite often interpreting your findings as such.

Response: Thank you for your recommendation. We will rewrite this sentence and checked the whole manuscript to let the illustration correct.

7.Page 6, line 17-20 – Biederman and Harpole, 2013 is another meta-analysis. They do not include any new data. Please include a reference that has shown that the transfer function presented in Line 19 is actually effective and robust at converting pH[H2O] to pH[CaCl2]

Response: Thank you for your recommendation. The reference showed the transfer function will be included.

8.Page 7, line 19 –Hedges' d does not allow you to determine the change in soil methane flux. It shows you the probability that fluxes increased or decreased for a given auxiliary variable. Page 8 Line 14 – 15 – Again, Hedges' d does not indicate increase or decrease, only the relative probability of an increase or decrease.

Response: Thank you for your comments. We will rewrite the description of the Hedges' d in this sentence, checked and rewrite the related description of all the manuscript to make the description are more convincible.

9.The Page 9 – Line 1. How have you measured skewness? What value did your analysis give? Why is this information not reported?

Response: Thank you for your recommendation. We will add the results of measured skewness for the total categories and subcategories.

10.Line 14 – 16. This is methods, not results and so should be removed from here. But here you state that you provide an "accurate view of the quantitative relationship". But you have probabilistic data, not quantitative data, so this cannot be correct!

Response: Thank you for your recommendation. We will rewrite this sentence.

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